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PATENT SPECIFICATION
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994.107



994.107

Date of Application and filing Complete Specification May 6, 1964.

No. 18930/64.

Application made in Germany (No. R35149 IVa/79c) on May 10, 1963

Complete Specification Published June 2, 1965.

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Index at acceptance: —A2 C(1E2, 1E3)

Int. Cl.:—A 24 c 5/50

COMPLETE SPECIFICATION

Method of Separating Out the Unwanted Ingredients of
Tobacco Smoke

ERRATA

SPECIFICATION No. 994,107

Amendment No. 1

Page 1, line 12, for "arrangement" read
"arrangements"

Page 1, line 19, after "of" insert "an"

Page 1, line 70, for "electrostatic" read "elec-
trostatic"

Page 1, line 72, for "denoteing" read
"denoting"

THE PATENT OFFICE

6th July 1965

or the like to the active burning site of the
cigarette. This filter arrangement is based
on the assumption that the positive ions and
the positively charged aerosol particles
present in the smoke impair the pleasure of
smoking but that slightly negatively charged
or neutral particles do not impair the pleasure
of smoking, and that the positive ions and
positively charged particles in the smoke also
have undesirable physiological effects by in-
hibiting partly or completely the activity of
the ciliary epithelium which lines the
pharyngeal space and which normally keeps
foreign bodies and substances out of such
space. The idea underlying this known
method is to remove the positive charges by
producing an electrostatic field between the
active burning side of the cigarette or the like
and the smoker's body.

However, it has been found—in contrast to

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which are the carriers of the unwanted ingre-
dients. Since the lungs or the pulmonary
alveoli can be regarded as a conductive sur-
face, the charged particles present in the
smoke are acted upon basically by an
attracting electrostatic force:

$$K = \frac{e^2}{4a^2}$$

e denoting the charge of the particle and a
denoting the distance from the surface. The
lungs therefore absorb such aerosol particles
to an extent dependent upon the quantity of
such particles present in the smoke, the ex-
tent being greater in proportion as the par-
ticles are charged more in one sense than an-
other, for otherwise the attractions of oppo-
sately charged particles can cancel one an-
other out.

The physiological events found in connec-

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COMPLETE SPECIFICATION

Method of Separating Out the Unwanted Ingredients of Tobacco Smoke

I, HANS JOACHIM FROHLING, of German nationality, of 4 Steiler Weg, Hamburg-Blankenese, Germany., do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a method of separating out the unwanted ingredients of tobacco smoke which impair the pleasure and wholesomeness of the smoke, and to filter arrangement for effecting the method.

A large number of methods and filter arrangements have already been proposed in an endeavour to achieve this purpose but they are either wholly or partly unsatisfactory. In a more recent known method a cigarette filter has inserted in it a filter element which is made of electrically conductive material and whose mouthpiece end is conductively connected to the smoker's body and whose other end is connected via the filter sleeve or casing or the like to the active burning site of the cigarette. This filter arrangement is based on the assumption that the positive ions and the positively charged aerosol particles present in the smoke impair the pleasure of smoking but that slightly negatively charged or neutral particles do not impair the pleasure of smoking, and that the positive ions and positively charged particles in the smoke also have undesirable physiological effects by inhibiting partly or completely the activity of the ciliary epithelium which lines the pharyngeal space and which normally keeps foreign bodies and substances out of such space. The idea underlying this known method is to remove the positive charges by producing an electrostatic field between the active burning side of the cigarette or the like and the smoker's body.

However, it has been found—in contrast to

the assumptions forming the basis for the known method—that the negative ions and negatively charged particles have a disadvantageous effect similar to that of the positive ions and positively charged aerosol particles. In testing the known method, we found that the effects which, in the disclosure of such method, are ascribed solely to the removal of the positive ions and positively charged aerosol particles can be produced by a highly negatively charged screen in the filter instead of a positively charged screen.

This is the starting point for the invention; the same provides a method which, as well as being able to remove the unwanted effect of positive ions and positively charged aerosol particles on the ciliary epithelium in the same way as does the known method, can keep away from the lungs in a manner which is much more useful so far as the wholesomeness of the smoke is concerned, positively and negatively charged ions and aerosol particles which are the carriers of the unwanted ingredients. Since the lungs or the pulmonary alveoli can be regarded as a conductive surface, the charged particles present in the smoke are acted upon basically by an attracting electrostatic force:

$$K = \frac{e^2}{4a^2}$$

e denoting the charge of the particle and a denoting the distance from the surface. The lungs therefore absorb such aerosol particles to an extent dependent upon the quantity of such particles present in the smoke, the extent being greater in proportion as the particles are charged more in one sense than another, for otherwise the attractions of oppositely charged particles can cancel one another out.

The physiological events found in connec-

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tion with the known method are of course due mainly to this effect and not to the negative ion effect which the inventors of the known method consider so beneficial; something which shows this quite clearly is that an unpleasantly harsh smoke was produced when, to prove our point, we applied very negative potentials, as well as very positive potentials, to the intermediate filter.

Starting from these considerations, the invention provides a method enabling a very high proportion of charged particles of any kind to be removed from the smoke before the same reaches the smoker's mouth, so that these particles, which are charged with tarry ingredients and so on, cannot reach the smoker's pulmonary alveoli. In the method according to the invention, the smoke gases are passed through an intimate mixture of two ingredients which are in the form of finely divided solid particles and which are present in equal quantities in the mixture, the particles of one ingredient forming electrodes of one kind and the particles of the other ingredient forming electrodes of the other kind, of a large number of galvanic microcells which become such by the aerosol particles which are precipitated on the "electrodes" at the beginning of smoking.

Theoretically, the ingredients of the mixture of fine particles could be of the various metals adapted to form the electrodes of a galvanic cell; unfortunately, the method cannot be carried into practical effect in this way, since a filter element must be provided which has properties appropriate for its particular use—i.e., as a filter tip for the cigarette or as a filter element in a filter holder for the cigarette. In a practical form of the method according to the invention, therefore, the two carefully mixed ingredients of the mixture comprise the same finely divided basic ingredients—for example very fine grains in the case of a filter holder and, in the case of a filter combined with the cigarette, very fine filaments—one half of which has a coating adapted to form one kind of electrode and the other half of which has a coating adapted to form the other kind of electrode. This leads to the formation of galvanic microcells each formed by two particles of a different nature from one another and having an individual voltage of something like 1 volt. If the distance between two such cells, for instance, filaments, is 10μ , the field strength in the smoke passage is about 1000 volts/cm.

The various coatings—for example copper or silver for one ingredient and zinc for the other—can be prepared fairly simply for example by vapour coating or spraying of such metals; the amounts of metal required are so small that they are scarcely perceptible optically, for the currents required are very small—some 10^{-12} to 10^{-9} ampere. The electrical

conductivity of metal layers even of this thickness is adequate.

Of course, mixing the two ingredients together does not lead to the same number of galvanic microcells as there are elements since microcell formation depends upon the physical interrelationship between the ingredients in the mixture; however, the number of microcells formed is always adequate for the predetermined effect.

When the invention is embodied in the form of an appropriate cigarette filter tip, the filter tow is formed by two ingredients each containing half of the individual filaments, the various metals having been applied to the ingredients by vapour coating, whereafter they are brought together in the filter strand. The galvanic cells each comprising two filament portions of a different nature from one another are formed immediately the first smoke products are precipitated on the filaments. Externally the filter is of course electrically neutral since the cells cancel one another out substantially exactly.

The possible uses of the new method are chiefly for the treatment of all kinds of tobacco smoke—cigarette, cigar and pipe smoke—and also, if required and with appropriate modification, in other cases where it is required to keep away from the human lung unwanted ingredients present in smoke of some other origin by such ingredients passing before being inspired, through an appropriate filter.

WHAT WE CLAIM IS:—

1. Method of separating out unwanted ingredients of tobacco smoke, which consists in passing the smoke gases through an intimate mixture of fine solid particles, one ingredient of which forms one electrode and the other ingredient of which forms the other electrode, of a large number of galvanic microcells which become such by the aerosol particles precipitated on such electrodes by the smoke.

2. Method as claimed in claim 1, wherein the mixture comprises identical carrier substances, each half of which has a different coating adapted to form a number of galvanic microcells.

3. Filter element for carrying out the method claimed in claim 1 and made of filter materials known *per se*, wherein substantially each half of the filter material ingredients, which are present in finely divided form, has a coating adapted to form either one or the other electrode of a galvanic microcell.

4. Filter element for carrying out the method as claimed in claims 1 and 2 and according to claim 3, wherein said filter element comprises portions of a filter tow including intimately mixed filaments provided with coatings, for example vapour coating or spraying, of two different metals adapted to form galvanic micro cells.

5. The method of separating out unwanted

ingredients in tobacco smoke substantially as herein described.

6. Filters for separating out unwanted ingredients in tobacco smoke substantially as
5 herein described.

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Leamington Spa: Printed for Her Majesty's Stationery Office by the Courier Press.—1965.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained